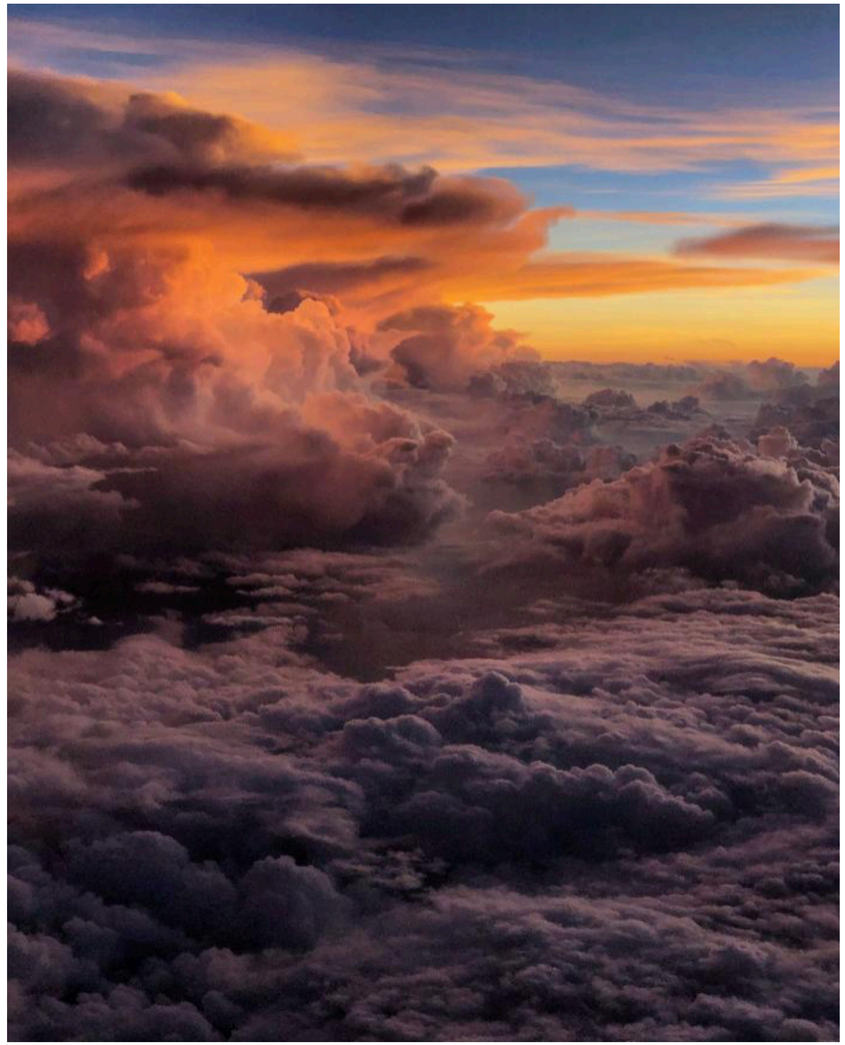
How to Run an STC

David Randall
Colorado State University

How to run an STC

I will tell you about some the keys to our success, and a couple of mistakes that I made along the way.



Clouds Are Central to the Earth Sciences

- Climate change
- Weather prediction
- The water cycle
- Global chemical cycles
- The biosphere

The ***Center for Multiscale Modeling of Atmospheric Processes*** (CMMAP, 2006-2016) was focused on improving the representation of cloud processes in global atmospheric models.

Through CMMAP, new ideas were conceived, formulated and tested by the university community, and adopted by many modeling centers around the world.

CMMAP also had a very active program to enhance STEM education and diversity.

Key to success #1

Jay Fein, NSF program manager

- Jay Fein funded my research for about 15 years before the CMMAP proposal.
- I visited Jay to ask his advice before starting to work on our proposal.
- Jay participated in some of our planning workshops, before the proposal was submitted.
- Jay was there at when we were site-visited.
- Jay helped us when we ran into difficulties.
- We could not have done it without him.

An STC “origin story”

The research concept came first, in late 2000.

The idea to make it the basis of an STC came in 2001.

I visited Jay Fein at NSF in early 2002, to ask for his advice about a possible STC proposal.

This 2003 article was based on an early draft of the 2003 STC pre-proposal.

BREAKING THE CLOUD PARAMETERIZATION DEADLOCK

BY DAVID RANDALL, MARAT KHAIROUTDINOV, AKIO ARAKAWA, AND WOJCIECH GRABOWSKI

Progress on the cloud parameterization problem has been too slow. The authors advocate a new approach that is very promising but also very expensive computationally.

CLOUDS AND CLIMATE: A PROBLEM THAT REFUSES TO DIE. Clouds of many varieties fill the global atmosphere (Fig. 1). They are composed of drops and crystals with scales on the order of microns to millimeters. They are associated with convection and turbulence on scales of meters to kilometers. They are organized within mesoscale and synoptic-scale dynamical systems that interact with the global circulation of the atmosphere.

The representation of cloud processes in global atmospheric models has been recognized for decades

FIG. 1. A full-disk visible image showing many cloud systems, including the intertropical convergence zone of the tropical eastern Pacific Ocean, marine stratocumulus clouds west of both South America and North America, and frontal clouds in the midlatitudes of both hemispheres.

AFFILIATIONS: RANDALL AND KHAIROUTDINOV—Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado; ARAKAWA—Department of Atmospheric Sciences, University of California, Los Angeles, Los Angeles, California; GRABOWSKI—National Center for Atmospheric Research, Boulder, Colorado

CORRESPONDING AUTHOR: David Randall, Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523
E-mail: randall@redfish.atmos.colostate.edu
DOI: 10.1175/BAMS-84-11-1547

In final form 25 March 2003

645 citations as of April 2019

Colorado State University

Knowledge to Go Places

http://kiwi.atmos.colostate.edu/cmmap/

UCLA

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Hampton U "Our Home by the Sea"

Geophysical Fluid Dynamics Laboratory 50th Anniversary 1955 - 2005 NOAA US DEPARTMENT OF COMMERCE

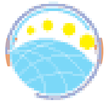
CATAMOUNT INSTITUTE

NCAR

NATIONAL CENTERS FOR ENVIRONMENTAL PREDICTION NCEP

the City College of New York

Australian Government Bureau of Meteorology



CCSR UNIV. TOKYO

JAMSTEC

UCSD

UCAR

Office of Science U.S. Department of Energy

UNIVERSITY OF MARYLAND

THE UNIVERSITY OF UTAH

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

UNIVERSITY OF WASHINGTON

IBM

AVML

THOMPSON SCHOOL DISTRICT Loveland-Berthoud Colorado

Poudre School District

The long and winding road

- Five planning workshops
- A pre-proposal
- A full proposal
- A site visit
- A year in "limbo"
- Success!

Jay Fein with two members of the site visit team

The team has a limbo party

The long and winding road

The long and winding road

- Your Wildest Dreams

The long and winding road

- Your Wildest Dreams

- Stairway to Heaven

The long and winding road

- Your Wildest Dreams
- Stairway to Heaven
- Sitting in Limbo

The long and winding road

- Your Wildest Dreams
- Stairway to Heaven
- Sitting in Limbo
- Heaven's Just a Sin Away

The long and winding road

- Your Wildest Dreams
- Stairway to Heaven
- Sitting in Limbo
- Heaven's Just a Sin Away
- Once in a Lifetime

Key to success #2

Cindy Carrick,
CMMAP's Managing Director

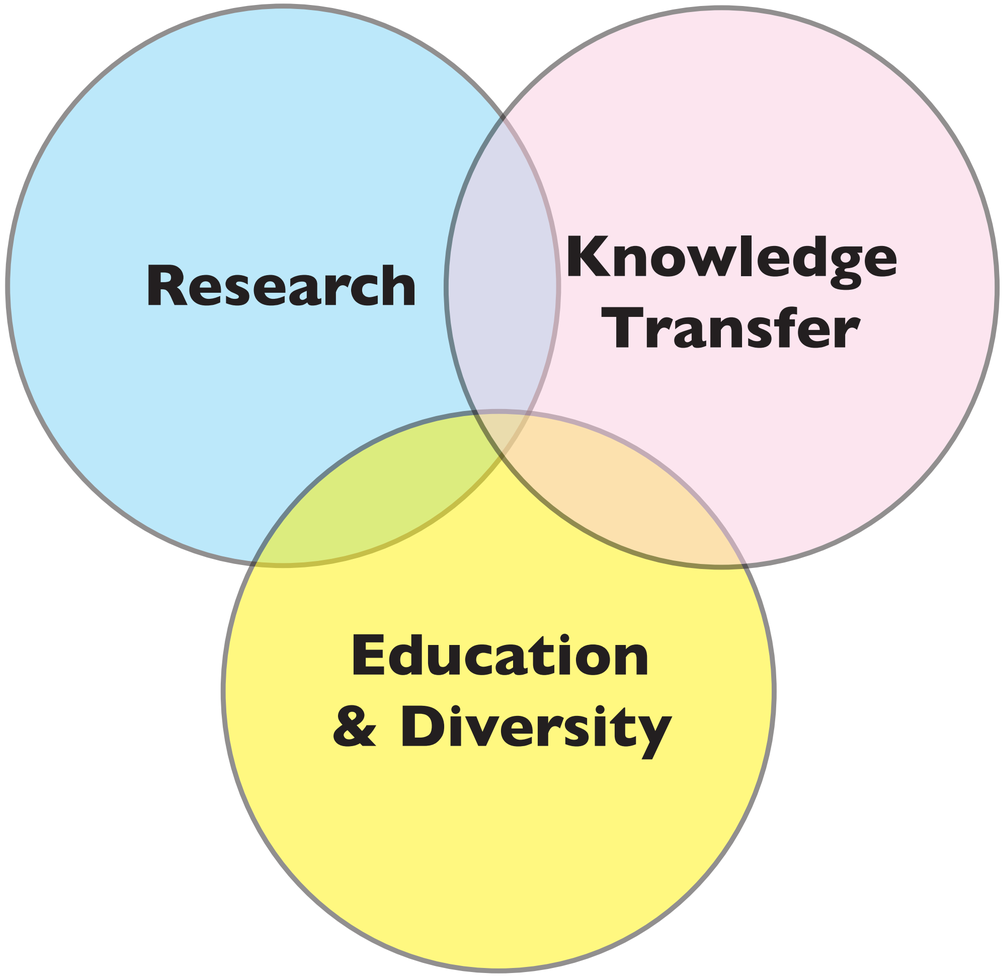
- Cindy Carrick had been working as my administrative assistant for about 15 years before we submitted the CMMAP proposal.
- During that time, she got to know most of my professional colleagues and gained some understanding of what the research was all about.
- She thought of CMMAP as "her" STC, and that was just fine with me.
- Her excellent organizational skills were key to our planning workshops, team meetings, etc.
- She also managed CMMAP's finances.
- She was key to the Center's success.

Mistake #1

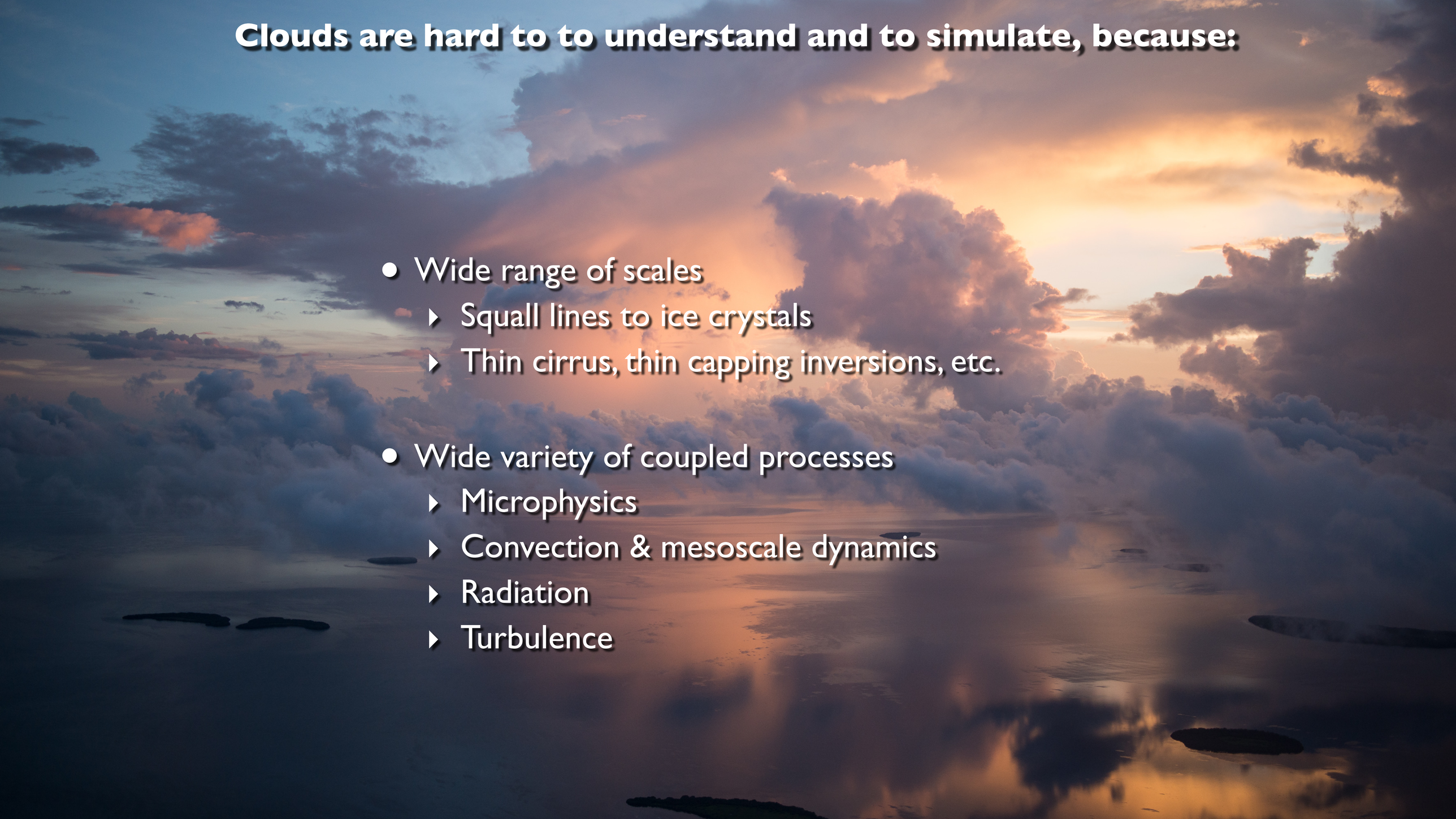
I did not ask for enough from my university before the proposal was submitted.

Asks

- Space
- Staffing
- Overhead stream


Research
Knowledge Transfer
Education & Diversity

An Overview of CMMAP's research



Clouds are hard to to understand and to simulate, because:

- Wide range of scales
  - Squall lines to ice crystals
  - Thin cirrus, thin capping inversions, etc.

- Wide variety of coupled processes
  - Microphysics
  - Convection & mesoscale dynamics
  - Radiation
  - Turbulence

Conventional Parameterizations

Global circulation

Cloud-scale
& mesoscale
processes

Radiation,
Microphysics,
Turbulence

Conventional Parameterizations

Global circulation

Cloud-scale
& mesoscale
processes

Radiation,
Microphysics,
Turbulence

Parameterized

At high resolution, parameterize less.

Global circulation

Cloud-scale &mesoscale processes

Radiation, Microphysics, Turbulence

Parameterized

CMMAP's Principal Innovations

Project	What it is	Status
First-generation super-parameterization	You already know	Versatile utility proven, and concept in use at many centers
Unified System of equations	Allows longer time steps by filtering vertically propagating sound waves	In use by CMMAP scientists
Vector vorticity model (VVM)	Cloud-resolving model that directly simulates convective vortex rings and rolls	In use at several centers
Quasi-three-dimensional (Q3D) super-parameterization	Second-generation super-parameterization	Being tested in CAM and E3SM
Unified parameterization	Scale-aware cumulus parameterization	Being tested in CAM and NGGPS
Improved parameterizations of radiation, microphysics, and turbulence	Just what it sounds like	In use at multiple centers
Global cloud-resolving model	Just what it sounds like	Being tested at CSU

Widespread applications of CMMAP's ideas

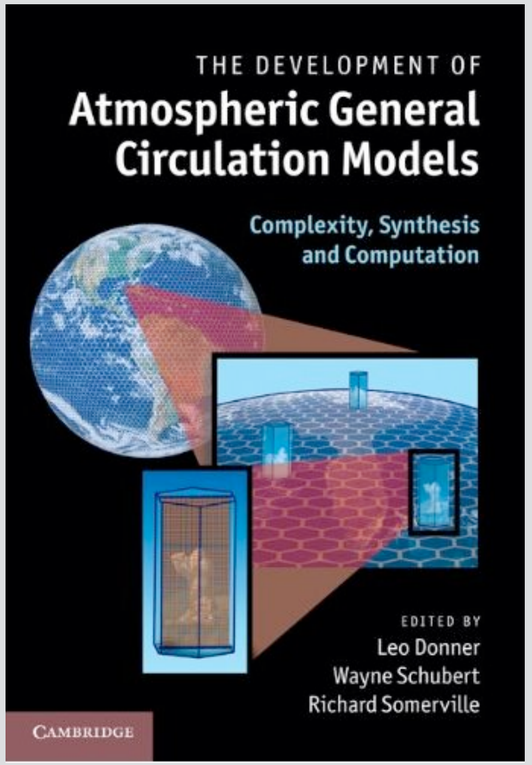
1. Colorado State University
2. NASA Goddard Space Flight Center
3. University of Washington
4. NASA Langley Research Center
5. Lawrence Berkeley National Laboratory
6. Scripps Institution of Oceanography
7. NOAA's Earth System Research Laboratory
8. National Center for Atmospheric Research
9. Pacific Northwest National Laboratory
10. Scripps Institution of Oceanography
11. State University of New York at Stony Brook
12. Massachusetts Institute of Technology
13. Indian Institute for Tropical Meteorology
14. Harvard University
15. University of Chicago
16. George Mason University
17. University of California at Irvine
18. ECMWF
19. University of Oxford
20. DOE's E3SM (formerly ACME)

Knowledge Transfer

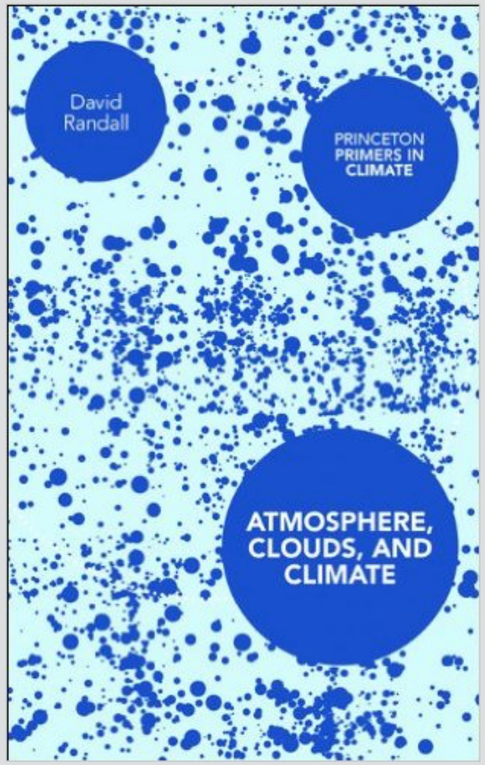
- CMMAP did not have private-sector partners.

- CMMAP did not have patents or other significant intellectual property issues. We published our results for anyone to use.

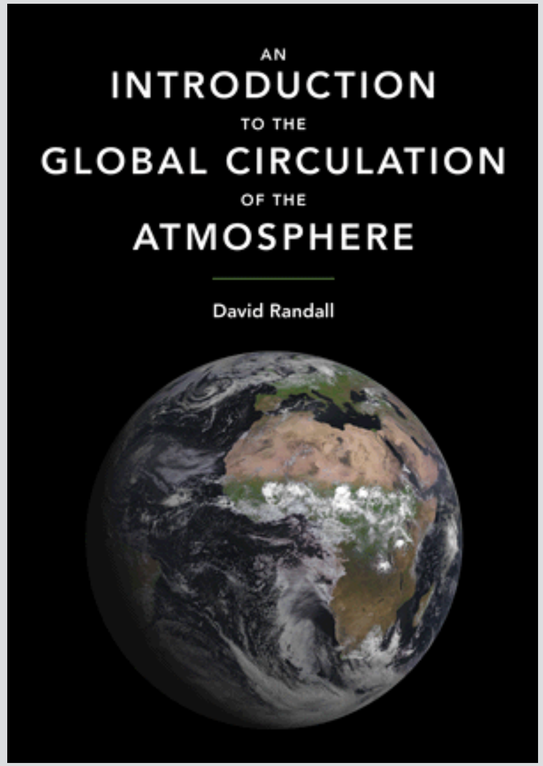
Three books



Historical overview

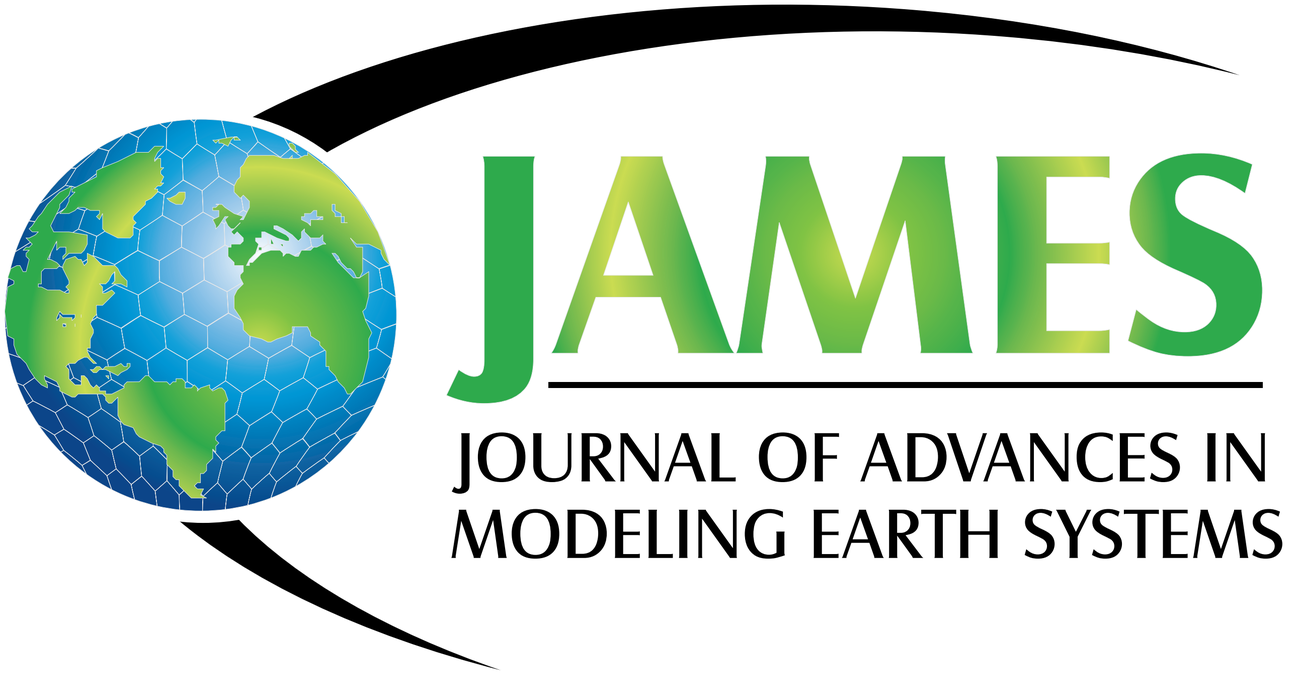


Undergraduate text



Graduate text

A new journal



Open access

Included in our proposal, and created in the CMMAP conference room

Adopted by the *American Geophysical Union* after one year

One of the highest impact factors in the field

Key to success #3

Scott Denning and Melissa Burt directed and managed CMMAP's Education & Diversity program. During the same years, Melissa completed her Ph.D. in Atmospheric Science.

Little Shop of Physics

School visits

Annual Open House

Hispanic Engr, Science, & Technology (**HESTEC**) Week

Pineridge Reservation

Colorado Rockies

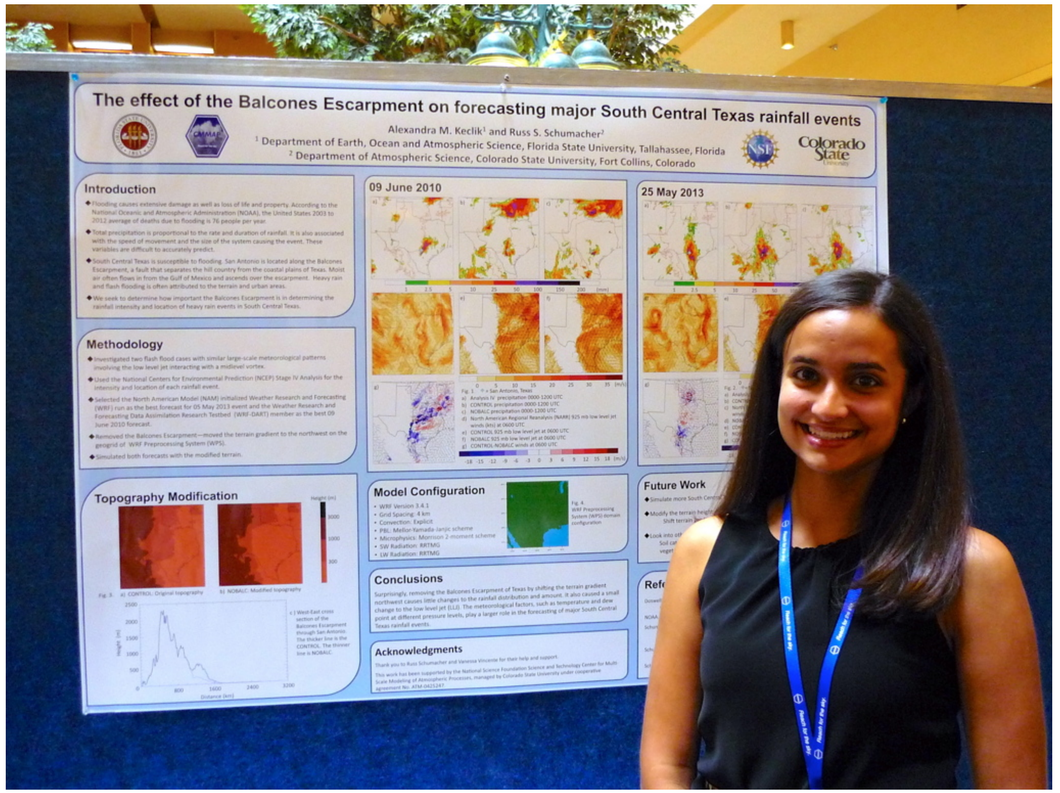
Namibia

Summer Internship Program

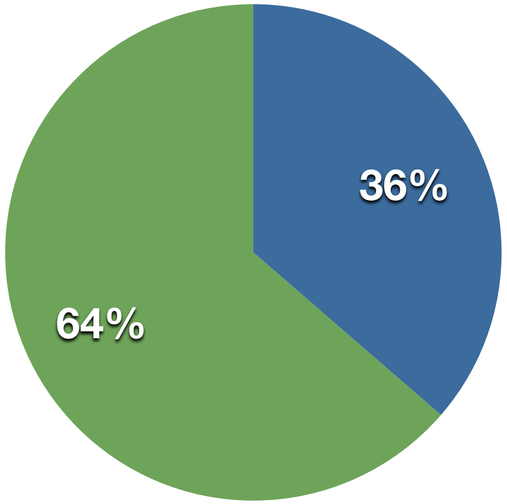
9 summers - 89 interns
Continuing through an REU-Site award

Interns

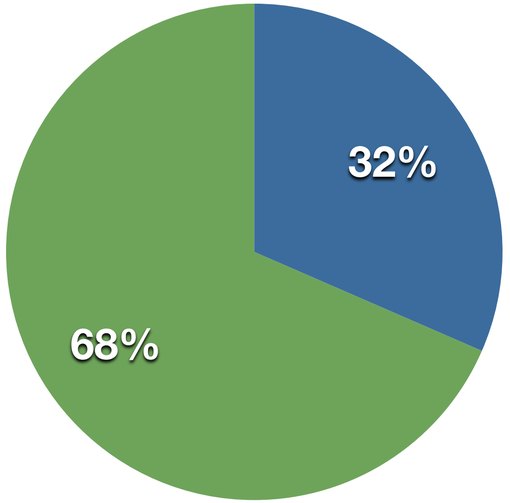
- Ten applicants for every opening
- Ten weeks doing research projects in Fort Collins
- Each intern mentored by a faculty member, a research staff person, and a graduate student
- Lots of social activities
- Oral presentation and poster session at the end of the summer
- Party at the end the summer
- Support to present work at a national meeting during the following winter
- Essentially all go to grad school, some at CSU



CMMAP supported CSU ATS Graduate Students

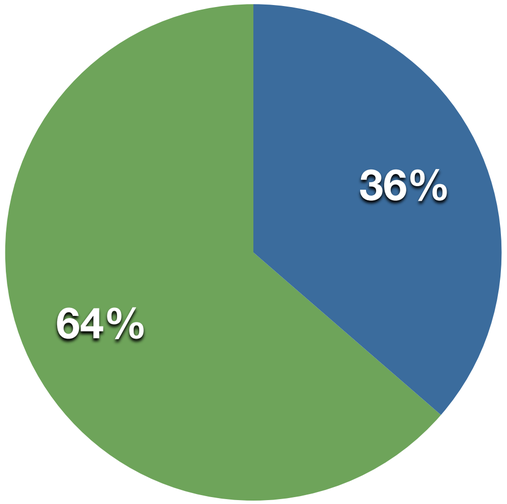


NSF S&E Indicators 2014 Graduate Enrollment

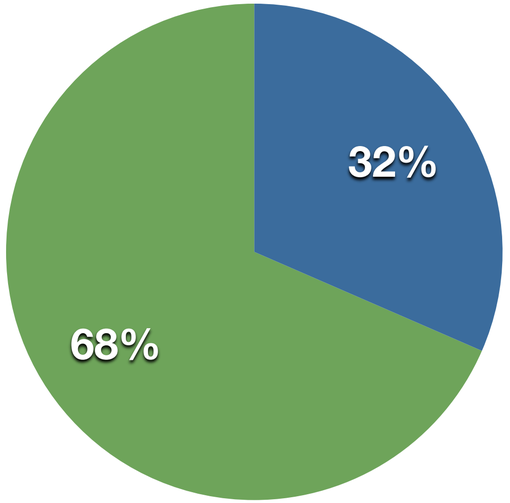


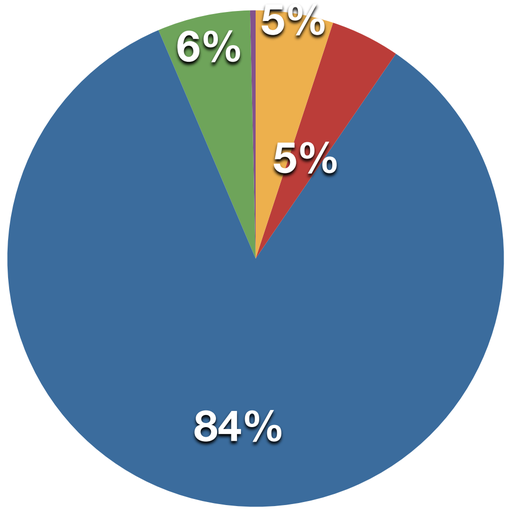
*CMMAP Graduate Students funded over Years 1-10, includes CMMAP ATS and CMMAP related project NSF IGERT
**nsf.gov - Women, Minorities, and Persons with Disabilities in Science and Engineering

CMMAP supported CSU ATS Graduate Students



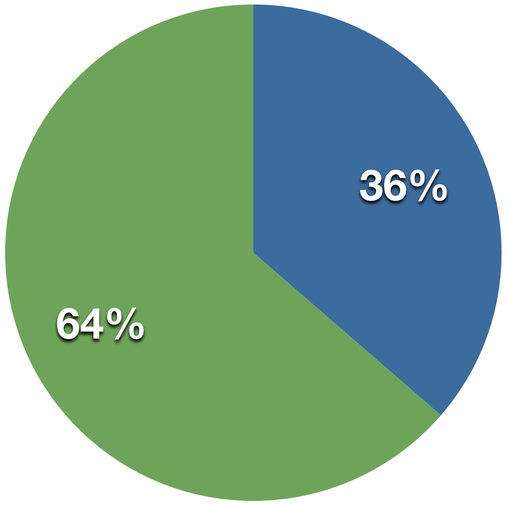
NSF S&E Indicators 2014 Graduate Enrollment





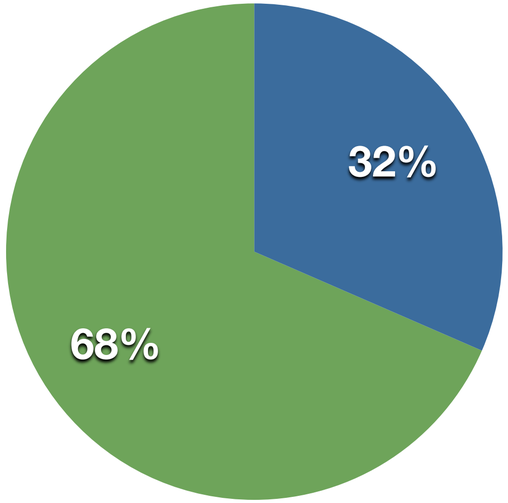
*CMMAP Graduate Students funded over Years 1-10, includes CMMAP ATS and CMMAP related project NSF IGERT
**nsf.gov - Women, Minorities, and Persons with Disabilities in Science and Engineering

CMMAP supported
CSU ATS Graduate Students

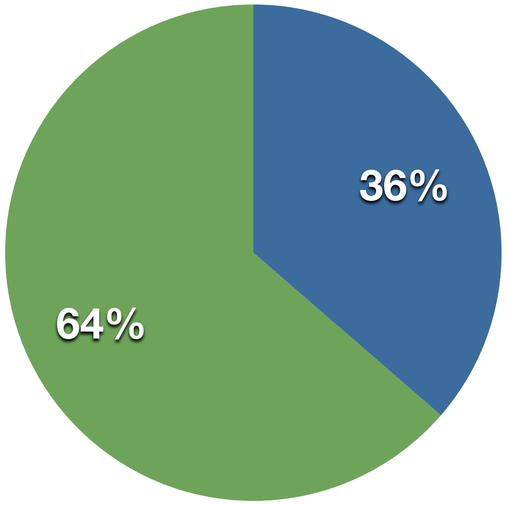


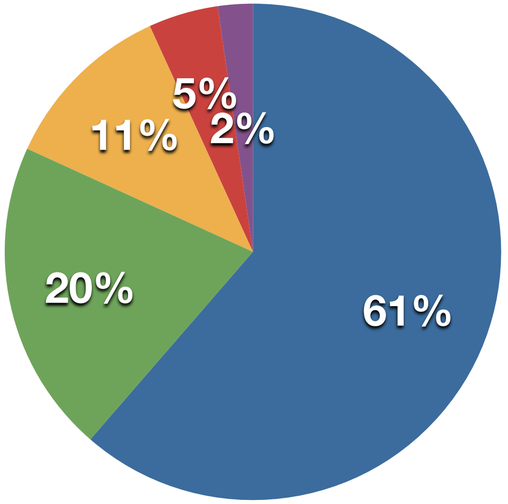
Female
Male

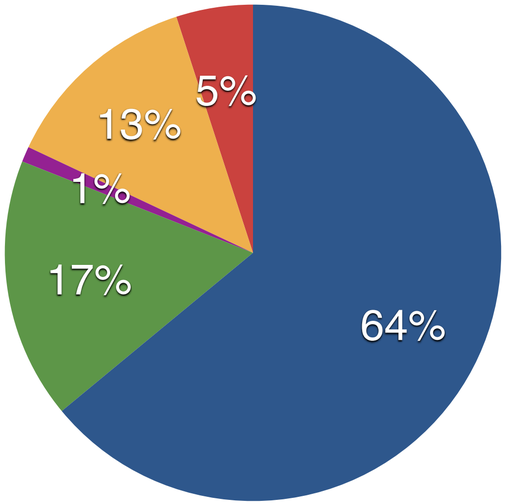
NSF S&E Indicators 2014
Graduate Enrollment



CMMAP supported CSU ATS Graduate Students

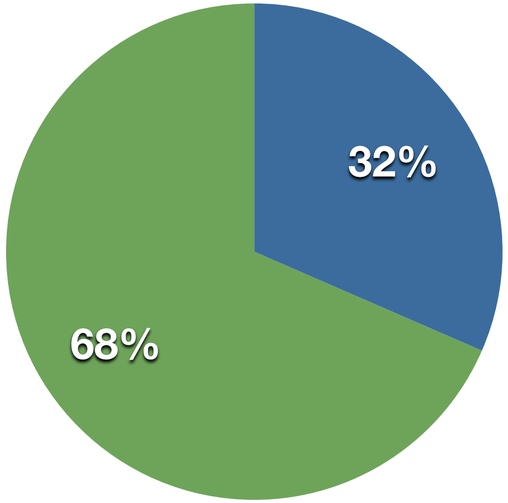


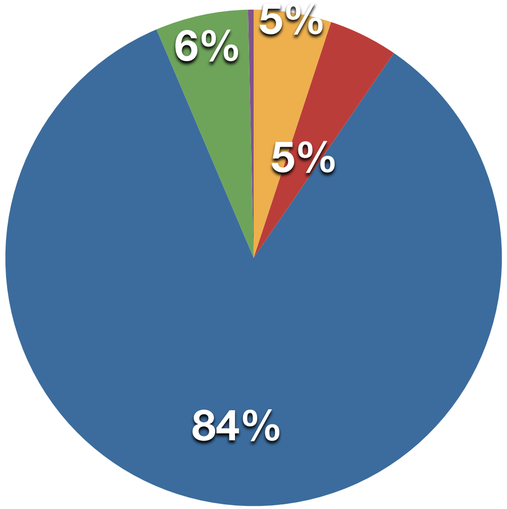




US Population

NSF S&E Indicators 2014 Graduate Enrollment

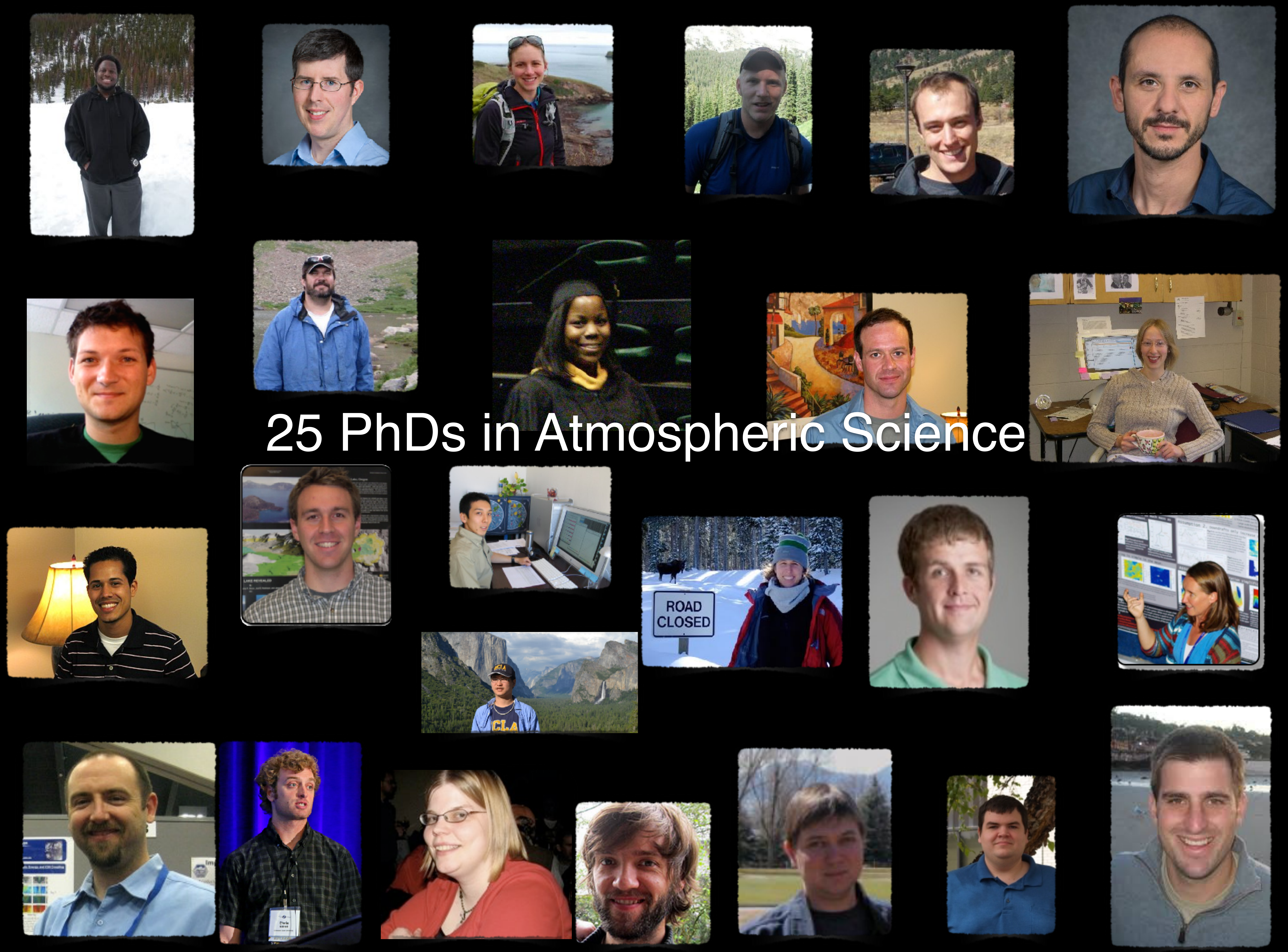




Teach the teachers

- CMMAP trained 333 teachers
- 12 from Tribal Schools
- 23 from outside Colorado (CA, WI, MN, IL, NYC, Italy)
- 6 from South Texas (HESTEC)

25 PhDs in Atmospheric Science



A year in the life

- January team meeting in a warm place
  - Two and a half days
  - External advisory panel observes and provides feedback
- Annual report due
- Site visit in the spring
  - Some team members travel
  - External advisory panel observes and provides feedback
- Interns arrive around June 1 and stay until early August
- Teacher training class
- July team meeting in Fort Collins
  - Two and a half days
  - External advisory panel observes and provides feedback
  - Intern poster session
  - Party

Mistake #2

I deliberately "stepped back" from too many things when we got the STC award.

Colorado State University

Knowledge to Go Places

http://kiwi.atmos.colostate.edu/cmmap/

UCLA

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Hampton U "Our Home by the Sea"

Geophysical Fluid Dynamics Laboratory 50th Anniversary 1955 - 2005 NOAA US DEPARTMENT OF COMMERCE

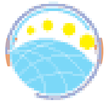
CATAMOUNT INSTITUTE

NCAR

NATIONAL CENTERS FOR ENVIRONMENTAL PREDICTION NCEP

the City College of New York

Australian Government Bureau of Meteorology



CCSR UNIV. TOKYO

JAMSTEC

UCSD

UCAR

Office of Science U.S. Department of Energy

UNIVERSITY OF MARYLAND

THE UNIVERSITY OF UTAH

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

UNIVERSITY OF WASHINGTON

IBM

AVML

THOMPSON SCHOOL DISTRICT Loveland-Berthoud Colorado

Poudre School District